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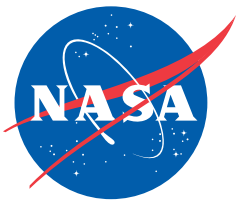

Workshop Report On
Improving Minority Institution Collaborations at NASA

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Report of a workshop
sponsored by and held at
NASA Ames Research Center
Moffett Field, California
on October 24-25, 2009

March 2010

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National Aeronautics and
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Executive Summary

On the weekend of October 24/25, 2009, NASA Ames hosted a workshop entitled "Improving Minority Institution Collaborations at NASA." One of the key objectives of the workshop was to determine how NASA could improve partnerships and strengthen collaborations with minority institutions. Seventy-three people attended the workshop including representation from most of the NASA Centers, representation from minority serving institutions, and wide representation from the African American, Hispanic and Native American communities. The energy created at the workshop was phenomenal.

To set the stage, an overview of NASA's Minority University Research and Educational Program (MUREP) was presented. The ultimate goal of MUREP is to employ a culturally diverse workforce into NASA's missions through partnering with Minority Serving Institutions (MSIs) to increase the number of underrepresented students who successfully pursue and complete degrees in NASA-related Science, Technology, Engineering and Mathematics (STEM) fields. Existing programs such as Motivating Undergraduates in Science and Technology (MUST), the Harriett Jenkins Pre-doctoral Fellowship Project, and the NASA Tribal College and University Project, were discussed to make sure that the minority community was aware of existing opportunities. Another focus of the first session was on collaborative models that have a proven success record, for example, the Meyerhoff Scholars program founded at the University of Maryland, Baltimore County. Another example is the NASA University Research Centers (URCs), whose broad goal is to develop a broad based competitive aerospace research and technology capability at minority institutions. There were several presentations during the workshop demonstrating the success of URCs in engaging minority serving institutions in the NASA research mission.

Contributed talks for the Saturday afternoon and Sunday morning sessions focused on experiences of minority institutions in working with NASA. General issues included how to build and sustain meaningful partnerships between NASA and minority institutions and collaborative models that have worked well. There was general consensus that NASA has the right spirit and understands the need to include minorities in their mission. The issue is how to best do that with the limited funds available. Throughout the workshop it became clear that to optimize the effort requires understanding the differences among minority serving institutions. For example, Tribal Colleges are very different from African American and Hispanic serving institutions. The main difference is that most are two-year colleges and this plays a large role in the availability of a pipeline and adequate resources including people to stimulate and interest students in STEM subjects and careers. Also, in our efforts to focus on minority serving institutions, there were repeated entreaties to not forget about minority students at majority serving institutions.

One of the key issues is communication. It was suggested that we establish liaisons at minority serving institutions whose role is to communicate what NASA programs are available to the students at the university and to help match the unique capabilities of each of the minority institutions with NASA opportunities. Also, greater use should be made of NASA ambassadors,

such as students who have been interns at NASA, to take information back to disseminate at their campuses. It was suggested that NASA have a technical conference each year where students could present their results. Using the NASA Astrobiology Institute (NAI) as a prototype, it was suggested that NASA form a virtual institute consisting of all minority-serving institutions. This would not only help NASA collaborate better, but might spur collaborations between MSIs. Effort should be made to create a web portal that would represent one-stop shopping for all NASA outreach events and opportunities.

There were a number of issues raised during the workshop that are worth summarizing here. For example, there are very large teaching loads in minority serving institutions. This makes it very difficult to carry out an active research program. NASA must more effectively address the issue of providing tenure-track academic positions for minority faculty who are actively engaged in research to increase the number of culturally relevant role models and mentors. The issue of sustainability was a constant theme throughout the workshop. While the NASA University Research Centers were in many cases very successful endeavors, concerns of sustainability past the initial funding period were continually expressed. One suggestion was to have a facility to train faculty members to compete more effectively for awards from the NASA Mission Directorates. There also needs to be better transparency in how to approach the NASA Mission Directorates for funding.

The Office of Education is rolling out a Performance Measurement System soon that will be helpful in evaluating the impacts of their programs. Good metrics are important and should include student employment, that is, what happens to students after they leave the program.

In the final session we asked the participants to summarize their key recommendations by asking them the question: "If you were in an elevator ride with NASA Administrator Charles Bolden, what would you say to him regarding the topic of the workshop?" The responses below represent a partial list of individual opinions, but taken together reflect the overall thinking of the attendees.

"The future of our scientific enterprise and our country's security depend upon NASA reaching and training underrepresented minority STEM professionals. New and effective ways to attract this continuously untapped resource must be developed."

"We need to convey the importance of NASA programs and how they bridge each other; for example, the NASA Administrator Fellowship Program provides a valuable linkage between NASA and minority institutions."

"We need focused communication to make it easy to find NASA information on its programs and opportunities. On the institution side, we need focal points for dissemination of NASA information."

"There's a great untapped resource eager to be fully engaged in the work of NASA's minority education programs. NASA can and must do a better job of identifying, tracking, stimulating and investing in those human resources who will make NASA successful in the future."

"Education is key to NASA sustainability of its mission—please don't compromise on education funding. Reach out to the cross section of the national communities—you will be amazed as to the raw talents waiting to be discovered. Listen to ideas from minority constituencies on ways to improve program reach and coverage."

"It struck me in this weekend's program that so many of the presentations focused on the heroic efforts of folks in academia and NASA. Yet we need to wrap an organizational strategy around these efforts, linked to the work of the Centers and NASA Mission Directorates, in order for this investment to be sustained as these folks move on in their careers.

"NASA can benefit with respect to students by being a lead agency in the development of the intellectual leadership in the core competencies. NASA can benefit with respect to maximizing its interactions with MSI faculty by improving dissemination of core information concerning NASA programs. NASA can benefit with respect to MSI universities by improving the impact of broadening participation in NASA sponsored programs."

"NASA should increase funding for research initiatives for minority institutions in interdisciplinary fields such as astrobiology. I believe the landscape of science is no longer the same and interdisciplinary science programs must become a priority in science education to increase the STEM pipeline. Astrobiology encompasses all sciences and it is one of the easiest and most effective ways to stimulate young minds".

"Please work to inspire all of American culture by educating and employing young people who want to support NASA's mission."

This NASA Conference Proceeding summarizes the workshop presentations and key discussion topics. The workshop participants felt that the education budget should be restored to previous levels to help ensure a sustainable future for NASA. In addition, we need to annually reassess if the correct amount of money is being spent on NASA Minority Education and if it is being spent in the proper manner. This requires that we, as an education community, focus more on the merit of our programs and their long-term impact on the workforce and on innovation. Demographic projections indicate that minority populations are increasing as majority populations decline in America. If NASA expects to maintain the intellectual rigor and curiosity that is interwoven throughout the Agency, it is imperative that we make academic and experiential investments early on with minority students and faculty who meet our high standards.

Workshop Report On
Improving Minority Institution Collaborations at NASA

Dr. Stephanie Langhoff[1], Karen Bradford[1], and Dr. Todd Gary[2]

I. Introduction

If NASA is to continue to be a world-class research organization, we must find ways to recruit the best and brightest diverse workforce for the future. To explore how NASA might do a better job of actively recruiting from minority institutions, we held a workshop entitled "Improving Minority Institution Collaborations at NASA" at Ames Research Center on 24-25 October 2009. It is part of a series of informal weekend workshops hosted by Center Director Pete Worden. Previous workshop reports can be found at http://event.arc.nasa.gov/main/index.php?fuseaction=home.reports. The Program Organizing Committee included Dr. Stephanie Langhoff (chair), Karen Bradford (co-chair), Brenda Collins, Lorraine Ruiz, Barbara Miller, Joy Pierre-Murphy and Melissa Kirven-Brooks from Ames Research Center (ARC); Mabel Matthews from NASA Headquarters; James Harrington and Dr. Benita Bell from Goddard Space Flight Center (GSFC); and Dr. Todd Gary from Tennessee State University. The organizing committee was responsible for the selection of speakers. The workshop was unique in that it brought together the leadership in NASA's education division and leaders in minority institutions throughout the United States. A list of the 73 attendees of the workshop and the workshop program are given at the end of the report.

In addition to trying to make the minority community aware of all of the NASA educational programs open to students from minority serving institutions, the workshop endeavored to answer the following key questions:

1. **How can NASA do a better job in recruiting from minority instutions (MI) and professional organizations?**
2. **How can we make employment opportunities within NASA more transparent to minority institutions?**
3. **How can we build partnerships and strengthen our collaborations with minority institutions, and what are the roadblocks and/or misconceptions that hinder progress?**
4. **What programs or models of collaboration involving MI work well?**

The workshop was divided into three major sessions: an overview of NASA's educational programs, especially NASA's minority university research and educational projects; building partnerships with minority institutions; and collaborative models and strategies for increasing minority participation.

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After the formal presentations, the workshop participants broke out into three separate groups to discuss the following questions in greater detail:

1. *What are the key strategies for initiating and sustaining partnerships?*

2. *What does NASA do well and what could they do better to strengthen collaborations with minority institutions?*

3. *What metrics and measurements are needed to monitor progress?*

This discussion is summarized in Section V.

In Dr. Pete Worden's introduction, he noted that while NASA is a leader in technological innovation, we also have a role in inspiring young people in STEM. Administrator Charles Bolden has made education an Agency priority. We will not accomplish our objectives in science unless we motivate all of our population. NASA has an aging workforce with many NASA employees eligible for retirement. This is our opportunity to make the Agency more diverse. The overriding goal of the workshop was to determine how we might best achieve those objectives. All the links cited in this report were valid as of 3/10/2010.

II. NASA's Educational Programs

II.1 Overview of NASA's Minority University Research and Educational Projects

Dr. Carl Person, manager of the Minority University Research and Education Program (MUREP) at NASA Headquarters, provided an overview of NASA's current activities sponsored by MUREP. The educational portfolio is based on the strategic framework of first inspiring and then engaging, educating, and employing a diverse workforce (see fig. 1). The focus is on attracting and retaining students in science, technology, engineering, and mathematics (STEM). The program spans informal, elementary/secondary, and higher education. Specific objectives of MUREP include: (1) facilitating NASA relevant research and development (R&D) activities at minority serving institutions (MSIs); (2) creating systematic and sustainable change at MSIs through partnerships and projects designed to strengthen their research and academic infrastructure; (3) preparing faculty and students at MSIs to successfully participate in the competitive research and educational processes of NASA; and (4) partnering with MSIs to increase the number of underrepresented and underserved students who successfully pursue and complete undergraduate and graduate degrees in NASA-related STEM fields.

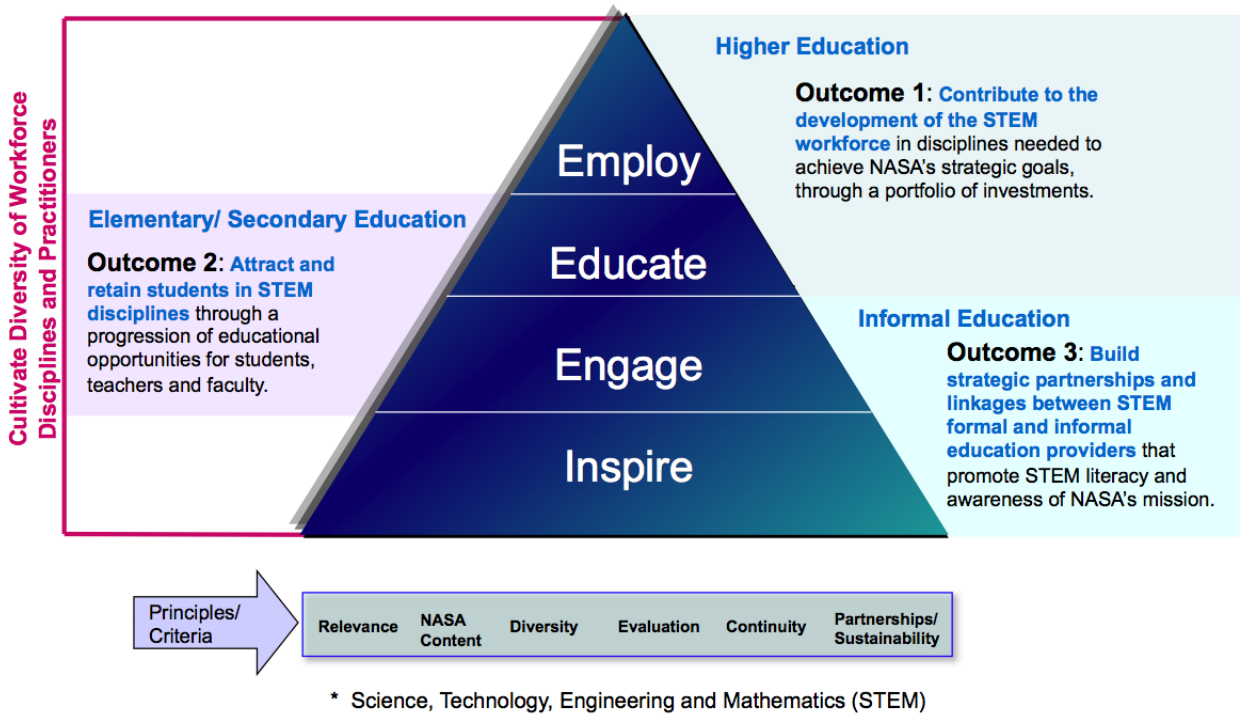

Figure 1. The Education Portfolio Strategic Framework.

Dr. Person provided an overview of the eight major MUREP projects shown in figure 2. The Motivating Undergraduates in Science and Technology (MUST) project is managed under a cooperative agreement by the Hispanic College Fund (HCF), the United Negro College Fund Special Programs (UNCFSP), and the Society for Hispanic Professional Engineers (SHPE). The program supports 100 undergraduate students pursuing degrees in STEM. A program overview is provided on the following website:
http://www.uncfsp.org/spknowledge/default.aspx?page=program.view&areaid=1&contentid=346&typeid=must

1. Motivating Undergraduates in Science and Technology (MUST)
2. Harriett Jenkins Predoctoral Fellowship Project (JPFP)
3. Curriculum Improvement Partnership Award for the Integration of Research into the Undergraduate Curriculum (CIPAIR)
4. NASA Science and Technology Institute for Minority Institutions (NSTI-MI)
5. MUREP Small Projects (MSP)
6. NASA Administrator's Fellowship Project (NAFP)
7. Tribal College and University Project (TCUP)
8. University Research Centers (URCs)

Figure 2. The eight major MUREP projects.

The Harriett Jenkins Pre-doctoral Fellowship Project (JPFP) provides 20 fellowships awarded annually for up to three years to support students in graduate school that are underrepresented in STEM disciplines. The program provides fellows with the opportunity to participate in a six-week "hands-on" NASA research experience. Details of the program can be found on the website:
http://university.gsfc.nasa.gov/programs/graduate/jpfp.html

The Curriculum Improvement Partnership Award for the Integration of Research into the Undergraduate Curriculum (CIPAIR) project has the objective of strengthening relationships between MI faculty and NASA centers. CIPAIR promotes the integration of NASA-related content and research opportunities into the MI curriculum and the involvement of students in program development and improvement. The project provides a three-year training grant to either two-year or four-year minority institutions. The program is administered by the UNCFSP. Details of the program can be found on the following website.
http://www.nasa.gov/offices/education/programs/descriptions/Curriculum_Improvements_Partnership_Award.html

The goals of the NASA Tribal College and University Project (TCUP) are to identify and remove barriers to TCU participation in NASA programs, to expand outreach activities to TCUs, and to enhance the TCU STEM infrastructure. The model for the 2009 program was to have TCU faculty-student teams go to one of the TCUs for a three-week project and then back to their home TCU for seven weeks to finish the project. This provides a more comfortable experience for the interns than the original format that had the student and faculty teams at a NASA Center for 10 weeks.

The MUREP small project (MSP) is an umbrella term for STEM education initiatives that are part of MUREP's portfolio. MSP supports a variety of activities for students, teachers, faculty, and researchers from underrepresented and underserved communities in NASA-related STEM fields. It is intended to provide seed funding to projects that address MUREP's priorities. Funding is up to $150,000 per year for three years. Further details of the project are provided on the following website:
http://www.nasa.gov/offices/education/programs/descriptions/Minority_University_research_Small_Projects.html

The NASA Science and Technology Institute of Minority Institutions (NSTI-MIs) project is designed to strengthen the research capabilities of both faculty and students at MIs. Managed out of Ames Research Center, the project provides faculty and students opportunities to collaborate with NASA scientists and engineers. The program has three components: a summer scholars program, institutional research clusters, and faculty fellowships. This project is described in more detail later in the report and on the website:
http://www.uncfsp.org/spknowledge/default.aspx?page=program.view&areaid=1&contentid=512&typeid=nsti55904

University Research Centers (URCs) are established at MIs to perform leading edge research in scientific or engineering fields that support NASA's mission directorates and to increase the number of underrepresented and underserved students at MIs who obtain advanced degrees in NASA-related fields. Awards are for five years, not to exceed $1 million per year, with at least 25% of the funding used to support undergraduate and/or graduate students. Details of some of the NASA URCs are presented later in the report. Further details about the URC project are also available on the website:
http://www.nasa.gov/offices/education/programs/descriptions/University_Research_Centers.html

The NASA Administrator's fellowship program (NAFP) seeks to enhance the professional development of NASA employees and STEM faculty at minority institutions. Faculty at MSIs either spend one year at a NASA center conducting research or a NASA employee spends one year at a MSI teaching and conducting research. The program increases the ability of MSIs to respond to NASA's overall research, development, and education mission. The program is administered by UNCFSP. For further details see the website:
http://university.gsfc.nasa.gov/programs/postgraduate/nafp.html

The project Achieving Competence in Computing, Engineering, and Space Science (ACCESS) is a 10-week paid internship at NASA centers. It is designed for undergraduate and graduate students with disabilities who have strong backgrounds in science and a desire to pursue technical careers. The program is managed in partnership with the American Association for the Advancement of Science (AAAS). See the following website for additional details:
http://www.nasa.gov/offices/education/programs/descriptions/Achieving_Competence.html

The NASA Aeronautics Scholarship Program supports both undergraduate and graduate students with internships to perform aeronautical research at a NASA center. Undergraduates are eligible to receive a 15K per year stipend for two years and a 10K summer internship at a NASA center. Graduate students are eligible to receive a 35K per year stipend for three years and two 10K NASA internships. See the website for additional details:
http://www.asee.org/nasaasp

Dr. Person ended by providing websites that provide more information about NASA's educational opportunities (http://education.nasa.gov) and NASA's research opportunities (http://nspires.nasaprs.com/). Clearly, there is already a robust educational program directed at increasing minority institution involvement in NASA's mission. Some of the discussion following his presentation was on metrics for judging the success of the programs in the portfolio. Dr. Person discussed the need to follow the progress of students in the programs not only through their educational pursuits, but also throughout their research careers. Current efforts are underway at NASA Headquarters to design and implement the Office of Education Performance Management (OEPM) database, which will systematically track students.

II.2 The Meyerhoff Experience: Addressing Diversity Through Excellence in Science and Engineering Education and Mentoring

Ernestine Baker is the executive director of the Meyerhoff Scholars Program at the University of Maryland, Baltimore County (UMBC), a midsize public university that was recently ranked number one among "up-and-coming" national universities by U.S. News and World Report. Minority students account for 35% of the UMBC enrollment (Black 14%, Asian 17%, and Hispanic and Native American, 4%). The Meyerhoff Scholars Program was established in 1988, primarily to address the shortage of African American males pursuing terminal degrees in STEM fields. Women were included in the program beginning in 1990, and currently the program is open to all high-achieving high school students. The ultimate goal of the program is to increase the number of underrepresented minorities who achieve doctorates in STEM fields. Since the program has served as a model for subsequent programs nationwide, it seemed appropriate to highlight this program early in the workshop.

The Meyerhoff Scholars Program provides the necessary academic advising, social and moral support, encouragement, and enrichment experiences that enable a diverse group of undergraduate students to succeed in STEM fields. Student selection is based on academic performance, recommendation letters, community service, interests in STEM fields, and the student's intentions to pursue a graduate degree in a STEM field.

It is the program philosophy that distinguishes the Meyerhoff Scholars program from other scholarship programs. One unique aspect is its comprehensive bridge program that is designed to transition the student from high school to the college level. The bridge program includes an introduction to university academics, site visits to nearby technical and scientific sites such as NASA's Goddard Space Flight Center and the National Institutes of Health, course work, and workshops on STEM subjects, study skills, public speaking, group study and social and cultural events. The bridge program is designed to build group cohesion and bonding, confidence, and to cope with the major barriers to success shown in figure 3.

1. Fear of disapproval/rejection by peers
2. Perceived hostile/unsupportive environment
3. Inadequate preparation for attitudinal/ behavioral demands of the Academy
4. Specific gaps in knowledge/skill development
5. Limited exposure to models of academic excellence and scholarly practice
6. Overall low expectations
7. Isolation
8. Financial aid

Figure 3. Barriers to Success

Another key to success is to involve the university in all aspects of the program. Administrative components include an institutional commitment to the program, financial support, involvement in the recruitment and selection process, and campus integration. The on-campus selection weekends includes faculty, staff, and the current Meyerhoff students. The parents are kept involved through program activities and by regular meetings to discuss class success and concerns. Students are encouraged to work in study groups, to take advantage of departmental and university tutoring resources, and to retake STEM courses in which they achieved "C" grades. The faculty serves as advisors and is involved in all aspects of the program. The staff assists students in arranging summer research internships in science and engineering.

The impact of the Meyerhoff Scholars Program on academic performance has been remarkable. Before the Meyerhoff program, UMBC graduated fewer than 18 African American science and engineering majors a year, and typically fewer than five of these graduated with a grade point average above 3.0. A study of the Meyerhoff program was conducted that looked at 5 key indicators of success, namely retention, academic performance, graduate program completion, impact on UMBC, and graduate placement. To date, the program has supported 768 students with 96% retention in the sciences and technical fields. Of the 508 Meyerhoff graduates, 86% earned bachelor degrees in science or engineering and 87% went on to graduate school. The high achievement of the Meyerhoff scholars (average GPA of 3.42) has raised the average GPA of all African American STEM graduates from 2.70 in 1989 to 3.21 in 2005.

The Meyerhoff Scholars Program has identified a number of key factors for success. These include the following: (1) students affiliated with learning communities are more likely to be successful; (2) a bridge program between high school and college helps "demystify" the transition process; (3) the program needs to be an integral part of the fabric of the university and should lend itself to the broader mission and purpose of the university; and (4) parental involvement and support is important at the college level.

Since 1992, 70 Meyerhoff scholars have published articles, including three that have reached the cover of the Journal of Molecular Biology. The program has clearly been a resounding success, worthy of duplication at other universities with similar objectives of improving the participation of minorities in STEM fields.

II.3 How to strengthen the STEM Scholars Programs that Target Minorities and Women

Dr. Bernice Alston, Deputy Assistant Administrator for Education at NASA, spoke about strengthening STEM scholarship programs. She outlined a number of elements that seem to be important in encouraging students to pursue STEM careers, including receiving a solid background in math and science, experience with hands-on content, exposure to role models and mentors, and interaction with peers who share a common interest. She illustrated how mind-altering events, such as communicating with the astronauts on the International Space Station (ISS) from the Oval Office, could change a student's career path. The importance of establishing a STEM pipeline to encourage women and minorities to purse STEM careers was stressed. The effort to engage students must begin in the middle schools and be sustained through high school, and at the college level through both undergraduate and graduate school.

Dr. Alston noted that scholarships make an important difference in a student's chances of completing a degree. She estimated that in this country there are about 850,000 students eligible for needs based support that do not apply. She cited Professor of Economics and Education Bridget Terry Long's aid simplification experiment at Harvard that is directed at helping parents fill out financial aid forms.

Recruiting and maintaining talent needs to be a key objective. It is not only necessary to strive for excellence, but to trumpet how good you are to build pride in the student body. She cited a report in U.S. News, previously cited by Ernestine Baker during her presentation, that ranked UMBC as one of the "up-and-coming" national universities and high on the list of public national universities in undergraduate teaching. The major goals of UMBC are to provide a distinctive undergraduate education, to continue to build the research and graduate education program, and to strengthen relationships with external partners. Nationwide, a minority of African Americans and Hispanic students who begin as science majors actually graduate with a STEM degree. The Meyerhoff program has been a major factor in achieving higher graduation rates at UMBC. Both the selection of students and the implementation of the program are important in achieving high grade point average (GPA) and graduation rates. Besides the Meyerhoff Scholars Program at UMBC, she mentioned several other very successful implementations such as:

(1) The Dozoretz National Institute for Mathematics and Applied Sciences (DNIMAS) program at Norfolk State University created to address the severe shortage of minority scientists in the basic and applied sciences.

(2) The Motivating Undergraduates in Science and Technology Project (MUST) funded by NASA as a joint partnership between the Hispanic College Fund, the United Negro College Fund Special Programs, and the Society for Hispanic Professional Engineers.

(3) The Louisiana Science, Technology, Engineering, and Mathematics (LA-STEM) Research Scholars Program at Louisiana State University (LSU), which focuses on scholarly undergraduate productivity and success.

An analysis of the four scholars programs is in its beginning stages. The data available has revealed distinct differences in ethnicity, institutions and availability of STEM majors, completion of STEM degrees and novel approaches to development of programmatic infrastructures. Ms. Ernestine Baker provided much of the information and data on the Meyerhoff Scholars Program from UMBC. Additional information is being provided on the NASA MUST Program and the Louisiana State University, LA-STEM Scholars Program.

The NASA MUST Program is very diverse, reporting the following diversity by ethnicity:

- 47% Hispanic/Latin
- 25% Black or African American
- 16% White (non-Hispanic)
- 6% Asian (non-Hispanic)
- 5% American Indian or Alaska Native

The diversity among institutions attended by the MUST students is a little less diverse in that 76% of the students attend majority institutions, and 9% attend historically Black Colleges and Universities. Most remarkable is that 47% of the students are Hispanic, but only 15% of the attended institutions are Hispanic-serving institutions.

The NASA MUST Program, since its inception in 2006, has identified the following results for Cohorts 1 and 2:

- 76% of students have completed an undergraduate STEM degree
- 24% are still pursuing an undergraduate STEM degree
- 18% work or intern at NASA
- 26% work or intern in the STEM Industry
- 45% of those graduated are pursuing an advanced STEM degree

The Louisiana State University LA-STEM program began in 2003 but has a smaller number of participants than the NASA MUST program. The diversity in ethnicity has a higher percent of White Non-Hispanic students:

- 53% White Non-Hispanic
- 33% Black Non-Hispanic

- 9% Asian/Pacific Islanders
- 4% Hispanic
- 1% American Indian

The 164 students involved in the program from 2003-09 yielded the following results:

- 24% graduates
- 48% active
- 9% reassigned to Howard Hughes Medical Institute
- 10% non-compliant
- 10% resigned

The small number of students entering the LA-STEM program annually developed high expectations for themselves. The graduates from LSU's LA-STEM program have matriculated to post-baccalaureate institutions that are very impressive. It includes the following institutions:

Columbia University	Texas A & M University
Duke University	The Ohio State University
Georgia Institute of Technology	Tulane Medical School
Louisiana State University	University of California-Irvine
Massachusetts Institute of Technology	University of North Carolina-Chapel Hill
Mount Sinai School of Medicine	University of Wisconsin-Madison
St. Joseph's University	Vanderbilt University School of Medicine
Columbia University	Wake Forest University

Dr. Alston is in the process of collecting comparable data on the Norfolk State DNIMAS Scholars Program. The DNIMAS Scholars Program is the senior program with 22 years of implementation. Meyerhoff Scholars Program has 21 years of implementation.

The distribution of STEM majors will be analyzed as a part of the research project. The selection of mentors, training for mentors and program evaluation will also be examined with each respective program.

The intent of this research project is to identify the proven practices in each scholars program and determine how, if at all, the four scholars programs can benefit from each other's experiences. An early observation is that each of these programs has exceptional components that have been pivotal in program success. There are also some common threads among the student participants, such as self-confidence and precociousness. As the NASA Office of Education develops innovative approaches to various aspects of STEM education, this study could result in valuable strategies for scholars programs, internships, and mentoring strategies.

In conclusion, developing STEM scholars has been portrayed as being easy as A, B, C: A- Activate by inspiring, B- Behavior/performance (giving STEM scholars the opportunity to perform with their diversity, uniqueness, and style), and C- Consequences (which governs how leaders act after accomplishing their goals).

II.3 NASA's University Research Centers: A Win-Win for NASA and Minority Institutions

Ms. Katrina Emery, University Research Center (URC) project manager at Dryden Flight Research Center, spoke about NASA's URC program, as a win-win for both NASA and minority institutions. The URCs contribute to the achievement of employing a diverse workforce at NASA and to maintaining NASA's commitment of achieving a broad based, competitive aerospace research and technology development capability at minority institutions. Key objectives of the program include establishing significant, multi-disciplinary scientific, engineering and/or commercial research centers at minority universities, and improving the rate at which U.S. citizens, who historically have been underrepresented in NASA-related fields, are awarded undergraduate and graduate degrees at their respective universities in NASA-related fields. Once the URCs have been established, there is increasing effort towards gaining support from sources outside the URC project by aggressively pursuing additional funding opportunities offered by the NASA Mission Directorates, industry, and other funding agencies. The target audience is faculty, undergraduate and graduate students at minority serving institutions.

The URCs are funded by a cooperative agreement for five years at $1M per year. To be eligible, the lead university must be a minority institution and must offer graduate degrees in a STEM discipline. At least 25% of the funding must go to support students. Twenty-six minority institutions have been funded over the course of 18 years that the program has been in operation. The URC program has been very successful, both in producing high-quality research and in graduating students in STEM disciplines. As an example, in 2007 the program produced 52 B.S., 39 M.S., and 11 Ph.D. degrees in STEM fields, produced over 200 publications, developed new STEM courses, and brought in over $26M in other government and industry funding.

The 13 current NASA University Centers are summarized in figure 4. Ms. Emery gave several examples of URCs that have been very successful endeavors. Howard University, which was one of the original URCs awarded nationally in 1992, developed an atmospheric sciences program that led to the establishment of an interdisciplinary masters and doctoral program—the Howard University program in atmospheric sciences (HUPAS). This has resulted in a close collaboration between Goddard Space Flight Center (GSFC) and HUPAS that allows NASA scientists at GSFC to be adjunct faculty and to teach courses at Howard University. This initial collaboration has resulted in a second URC at Howard University that establishes a basis for an even broader interdisciplinary collaboration in atmospheric sciences.

1. **California State University, Long Beach**
   The Center for Human Factors in Advanced Aeronautics Technologies (CHAAT)
2. **California State University Los Angeles**
   NASA URC SPACE Center
3. **Delaware State University**
   Establishment of a NASA Optical Sciences Center for Applied Research (OSCAR)
4. **Florida International University**
   WaterSCAPES: Science of Coupled Aquatic Processes in Ecosystems from Space
5. **Howard University**
   Howard University Beltsville Center for Climate System Observation
6. **Morgan State University**
   Center of Excellence in Systems Engineering for Space Exploration Technologies
7. **North Carolina Agricultural and Technical State University**
   Center for Aviation Safety (CAS)
8. **North Carolina Central University**
   NASA Center for Aerospace Device Research and Education
9. **Prairie View A & M University**
   The Center for Radiation Engineering and Science for Space Exploration (CRESSE)
10. **Texas Southern University**
    Center for Bio-Nanotechnology and Environmental Research (C-BER)
11. **University of Puerto Rico, Rio Piedras**
    Center for Advanced Nanoscale Materials
12. **University of Texas at Brownsville**
    Center for Gravitational Wave Astronomy (CGWA)
13. **University of Texas at El Paso**
    Center for Space Exploration Technology Research (cSETR)

Figure 4. The 13 current NASA University Centers.

Another example of a highly successful collaboration is between Ames Research Center (ARC) and the URC at Texas Southern University (TSU), the Center for Bio-Nanotechnology and Environmental Research (CBER). ARC and TSU worked together to conduct a life science flight experiment, Microbial-1, on board the recently launched space shuttle mission (STS-129). This interaction gave students at TSU a first hand experience with the space program.

For a URC to be successful it should have a clear strategic vision, be aligned with NASA research interests, have a strong human capital development program in the STEM areas, involve innovative partnerships, and have a sustainability plan. A significant aspect of the discussion that followed the presentation was on ways to sustain a URC after the five-year cooperative agreement ended. Further discussion of several URCs is presented later in the workshop proceedings.

II.4 NASA Ames Minority Institution Education Outreach

Brenda Collins, higher education program manager at ARC, spoke about existing collaborations between ARC and minority institutions. ARC is involved in three University Research Centers (URCs). The first URC is the Center for Bio-Nanotechnology and Environmental Research with Texas Southern University. The principal investigator (PI), Dr. Olfisayo Jejelowo, describes this collaboration later in the report (see section IV.6). The second URC is the Center for Advanced Nanoscale Materials with the University of Puerto Rico. NASA Glenn Research Center (GRC) and the Jet Propulsion Laboratory (JPL) are also collaborators on the project. Ileana González-González, a doctoral student of the PI, Dr. Carlos Cabrera, gives an overview of this URC later in section III.10. The third URC that Ames is collaborating with is The Center for Human Factors in Advanced Aeronautics Technology at California State University at Long Beach. This URC is focused on the evaluation and design of air traffic management (ATM) concepts and technologies necessary to achieve the goals of the Next Generation Air Transportation System (NextGen). Its secondary goal is to advance and expand NextGen-relevant human factors training to students from underrepresented groups.

Brenda Collins spoke about pre-service teacher programs that are conducted at California State University (CSU) Fresno through a cooperative agreement with ARC. The pre-service teacher STEM Institute at CSU is a two-week program designed to stimulate the interest of prospective elementary and middle school teachers. The pre-service teacher research cluster project at CSU is an eight-week program designed to provide an environment of real world scientific inquiry to pre-service teachers.

Another program that is managed out of ARC in collaboration with the United Negro College Fund Special Programs (UNCFSP) is the NASA Science and Technology Institute for Minority Institutions (NSTI-MI). This program was established in 2006 to provide leading-edge research opportunities for faculty and students from MIs that complement NASA's research programs and make original contributions to NASA in astrobiology, biotechnology, information technology, energy, emerging technologies, and environmental research. One aspect of the UNCFSP-NSTI program is the information and emerging technologies cluster (UNITE), which conducts research in the areas of supercomputing, networking, intelligent systems, aeronautics, and thermal protection systems. The institutions in the cluster are Tuskegee University, Southern University, CSU Fullerton, Texas Southern, and San Francisco State University.

In addition to the programs above, ARC has research grants with CSU Monterey Bay for remote sensing and ecosystems modeling research, CSU Long Beach for aeronautical research, and Tennessee State University to run the minority institute sabbatical program for the NASA Astrobiology Institute.

II.5 How to Propose Research to NASA ARC

Bea Morales, grant officer at ARC, discussed the mechanism for proposing work to NASA and in particular, ARC. The authority that NASA has to collaborate with outside agencies is through the Space Act of 1958. One key mechanism for obtaining funding is to submit a research proposal in response to a NASA solicitation. There are three unique types of solicitations, namely NASA research announcements (NRAs), cooperative agreement announcements (CANs), and announcements of opportunity (AOs). Solicitations are posted on the web (e.g., NASA Solicitation and Proposal Integrated Review and Evaluation System (NSPIRES) http://nspires.nasaprs.com/external/ and the NASA Automated Information System (NAIS) (http://prod.nais.nasa.gov/cgi-bin/nais/index.cgi). Guidance on responding to a solicitation is elaborated in the NASA Grant and Cooperative Agreement Handbook, which can be obtained from the website (http://prod.nais.nasa.gov/pub/pub_library/grcover.htm) and the NASA Research Announcement (NRA) for proposers guidebook located at (http://www.hq.nasa.gov/office/procurement/nraguidebook/). Research proposals submitted to these solicitations are competitively selected.

A second mechanism to obtain funding is through an unsolicited proposal. These must be innovative, unique, and independently originated and developed by the offeror. These proposals are not competitively selected, but are reviewed by NASA centers for relevance and benefit to NASA's research objectives. Proposals may be funded if program funds are available to support the proposed research. Guidance for the preparation and submission of unsolicited proposals can be obtained from the website http://prod.nais.nasa.gov/pub/pub_library/unSol-Prop.html.

Two additional types of award instruments are grants and cooperative agreements. Grants can be used for research, education, and training. Cooperative agreements are distinguished from research grants in that they involve substantial involvement between NASA and the recipient during performance of the research. The final award instrument is a procurement contract, which is a mutually binding legal relationship obligating the seller to furnish supplies or services to the buyer. This usually involves acquisition of a well-defined specific effort for a NASA mission or project. NASA Headquarters has established the NASA Shared Services Center (NSSC) to award and administer the Agency's grants and cooperative agreements.

III. Building Partnerships with Minority Institutions

III.1 How My Students Ended up Playing Baseball with Aliens: "Impact" of the NASA Astrobiology Minority Institution Research Support

Dr. Aaron Cavosie, associate professor of geology at the University of Puerto Rico Mayaguez (UPRM) campus, discussed the impact that NASA's Astrobiology Institute Minority Institution Research Support (NAI-MIRS) program has had on students from the University of Puerto Rico. The NAI-MIRS program was initiated in 2002 by Karen Bradford and Dr. Baruch Blumberg at the NASA Astrobiology Institute (NAI) (http://astrobiology.nasa.gov/nai). In 2005, the NAI began collaborating with Tennessee State University to grow and strengthen the program that now provides summer sabbaticals, follow-up support, and travel opportunities for faculty and students from minority institutions. Other presenters at this workshop describe the impact of participating in the NAI-MIRS program: Erik Melchoiree ((see section III.3), Michael Ceballos ((see section IV.1) and Yolanda Serrano ((see section IV.7). More information on the NAI-MIRS program can be found at www.nai-mirs.org

UPRM is a U.S. minority serving institution located on the west coast of Puerto Rico with approximately 12,000 undergraduate and 1000 graduate students. Dr. Cavosie received sabbatical and research support from the NAI-MIRS program in 2009 to conduct impact crater studies at the University of Wisconsin (UW).

Dr. Cavosie's experience in the NAI-MIRS program led to several observations. Since minority schools are usually broke, conservative, and not research-oriented, faculties need be resourceful in looking for research opportunities outside of MIs. There are also language concerns that need to be dealt with since UPRM resides in a native Spanish speaking land. Finally, MI faculty members need to find academic partners involved in NASA research such as UW, that are interested in the participation of minority students in their NASA-related programs.

Dr. Cavosie ended by explaining why he titled his talk "How my students ended up playing baseball with aliens." During the summer program, his students were involved in "Starwars and Astrobiology Night" at Mallard's stadium in Madison, Wisconsin. There were 6,432 people who attended to watch baseball and learn about astrobiology. There were a number of fun events, such as a tug of war between the "aliens" and the kids (the kids won). Overall, this was a clever way to teach a little astrobiology to people not typically exposed to such disciplines.

III.2 What's in a Word (or a Picture)? Constructing and Demolishing Roadblocks to Community

Dr. Linda Billings, research professor in the School of Media and Public Affairs at George Washington University, spoke about constructing and demolishing roadblocks to community. She specifically addressed how we could build partnerships and collaborations with minority institutions

and indentify the roadblocks that hinder success. She addressed the power of unknowledged assumptions and beliefs and talked about the potentially damaging power of ideas that we prefer not to talk about. She suggested that ideas and beliefs based on false assumptions may be hindering NASA's efforts to expand and strengthen collaborations with minority institutions.

Dr. Billings asked participants to think about how NASA historically and presently has presented itself to people outside the space community, and how the power of verbal and visual rhetoric may welcome or repel 'outsiders.' She posed the question of whether NASA is truly a welcoming organization. Of course that depends on your point of view. She discussed the concept of a self-fulfilling prophecy, a term coined by Robert K. Merton in 1948. A self-fulfilling prophecy is a socially constructed "reality" that is the product of, and depends for its existence on, assumptions, ideas, and beliefs that have no basis in physical reality. "The self-fulfilling prophecy is, in the beginning, a false definition of the situation." Again quoting Merton, Dr. Billings noted, "Blind panic, aggression, and prejudice are not rooted in human nature, but are the product of the modifiable structure of society." Society must reject social fatalism that human nature is unable to affect change that brings a greater tolerance of the genetic differences between and among individuals and groups.

Dr. Billings discussed how to communicate effectively and productively in cultural situations that are initially unfamiliar, even threatening. Listen to what people say about "local" codes of communicative conduct, search through the communal conversation in all its modalities, and submit to the complexities of cultures and communal life. She ended by quoting sociologist Orlando Patterson: "Will President Barack Obama, who delicately straddles both worlds of immigrant success and black identity, be able to broaden the inclusion of African Americans?"

III.3 Bridging the Gap: Case Studies of What Works Well in the Preparation of Students from Traditionally Underrepresented Groups for a Future Career in the Space Sciences.

Dr. Erik Melchiorre, associate professor of geology at California State University, San Bernardino, spoke about how to bridge the gap so that students from underrepresented groups can graduate and transition to work for NASA. His research project was to study terrestrial analogs for astrobiology and to identify extremophile "fingerprints." Funding for the research came from a California Space Grant, the McNair Scholar summer program awards, and the NASA Astrobiology Institute (NAI) minority institution research sabbatical (MIRS) program. The NAI-MIRS sabbatical program in astrobiology funds faculty and students from minority institutions to engage in a sabbatical focused on research in astrobiology. Considerable fieldwork was required in this research project, since samples were being taken from extreme environments such as high salinity lakes and deep within subduction zones. The sabbatical program allowed follow-up work at the University of Hawaii using advanced instrumentation to perform isotopic and chemical analysis of the field samples. Extremophile bacteria (archea) from arid, super-saline environments have unique, easily identified isotopic signatures.

While many tools are in place to facilitate instruction of students from underrepresented groups, Dr. Melchiorre felt that these must be preserved and expanded. While appreciating having student stipends, he felt they should include additional funds for health care coverage, travel, and research funding. In addition to ensuring that academic programs at MSIs stay open and viable, additional effort is required to establish a "bridge" so that the participants and graduates of these programs may transition to NASA.

III.4 National Hispanic University Collaborations with Ames Research Center

Dr. David Johnson, Director of Development at The National Hispanic University (NHU) in San Jose, California, spoke about collaborations between NHU and ARC. NHU was established in 1981 to serve the needs of Hispanics, women, and other minorities. Dr. B. Roberto Cruz was the founding president and its academic visionary for 22 years. In 1997 NHU and ARC signed a memorandum of understanding (MOU) in "commemoration of mutual interests in educational outreach and potential research collaborations between NASA and The NHU." This made it easier for ARC scientists and engineers to become engaged in NHU activities. For example, Ruben Ramos, an ARC engineer, has devoted 16 years of volunteer time to NHU students, and Phil Luna's presence on campus set the stage for the creation of the NHU department of mathematics and science. ARC personnel have been involved in the design of NHU's laboratories.

Dr. Johnson discussed some of the activities on the NHU campus. The Latino College Preparatory Academy (LCPA) is a charter high school created jointly between The National Hispanic University and East Side Union High School District. The goal of the school is to help students graduate from high school proficient in English, Spanish and computers and have an opportunity to attend college. Mark Leon and the ARC education office have been strong supporters of both NHU and LCPA. Hispanic students at NHU have been involved in the Carnegie Mellon robotics camp that is offered each summer in collaboration with ARC. A Minority University Mathematics, Science and Technology Awards for Teacher and Curriculum Enhancement Program (MASTAP) grant from NASA enabled NHU to begin offering teaching credentials in mathematics and science. Although the NHU-ARC collaboration waned in 2006 due to cuts in the NASA educational budget, the ARC-NHU collaboration has been rekindled by the current ARC director, Dr. Pete Worden. A new MOU has been signed recently between NHU President David Lopez and ARC Director Pete Worden.

Dr. Johnson ended by discussing three take home messages: (1) NASA's policies that help build capacity at minority serving institutions positively impacts those institutions; (2) What NASA gives, it can take away, and when it does there can be immediate adverse consequences for minority serving institutions; and (3) People count—when NASA employees participate in the education of the next generation of scientists and engineers it makes a difference. "For our students, science and engineering have become real because they get to work side by side with real NASA scientists and engineers at ARC."

III.5 Minority and Women Training in Photonics

Dr. Robert Alfano, distinguished professor of physics at City College of New York (CCNY) and Director of the Institute for Ultrafast Spectroscopy and Lasers (IUSL), discussed his experiences training minority and women students in advanced photonics. A significant source of funding for IUSL has come from NASA. From 1994-2002, CCNY received a NASA Institutional Research Award (IRA) grant entitled "Tunable Solid-State Lasers and Optical Imaging", and from 2003-2008, a NASA University Research Center (URC) grant entitled "Optical Sensing and Imaging for Earth and Environment."

Dr. Alfano gave a brief introduction to the processes of emission, absorption, and scattering of light. He showed how visible and ultraviolet light is used to excite electronic states and how near infrared radiation is used to excite the vibrational manifold of the ground electronic state. Photonics include a range of disciplines such as linear and nonlinear optics, optical fibers, lasers, photodetectors, imaging, and modulation. Applications broadly span areas such as communication, computation, medical imaging and diagnosis, biophysics, chemistry, and solid-state physics.

IUSL offers hands-on training for students in cutting edge areas of photonics. The goals of the program for students are to learn the basic principles of optics, spectroscopy, and lasers, and to join a research team focused on a specific project. Each research team consists of a leader (faculty or postdoctoral researcher), 1-2 graduate students, 1-2 undergraduate students, and 1 high school student. The goals of the team are to perform research with cutting edge instrumentation and hands-on training leading to journal publications. To date, IUSL has produced 50 Ph.D. graduates of which 5 are minorities and 7 are women. This past summer 5 high school students entered the program.

Dr. Alfano gave several examples of research projects within IUSL. These include the growth of tunable laser crystals, studies of the nonlinear processes that produce a supercontinuum, pulse propagation through scattering walls, optical imaging, and other state-of-the-art photonics.

Experiences within IUSL show that high school, undergraduate, and graduate students can learn state-of-the-art lasers and their applications, but NASA funding is vital to allow hands-on training. The program has also produced collaborations with industry, which is leading to the implementation of student internships at leading companies such as Corning, GE, Lockheed Martin, IBM, Philips, Northrup Grumman, and Ocean Optics.

III.6 The Accomplishments and Challenges of the SPACE University Research Center

Dr. Helen Ryaciotaki-Boussalis, Director of the Structures, Propulsion, and Control Engineering (SPACE) Center at California State University, Los Angeles (CSULA), spoke about the SPACE Center's research. The SPACE Center was awarded funds as a NASA University Research Center (URC) to work in partnership with DFRC and JPL until 2013. Within the Center there are two laboratories—the SPACE laboratory, and the multidisciplinary flight dynamics and con-

trol (MFDC) laboratory. These laboratories conduct research relevant to NASA's Aeronautics Research Mission Directorate, e.g., on combustion and uninhabited aerial vehicles (UAVs). The laboratories also support NASA's Exploration Systems Mission Directorate, e.g., in the development of James Webb Space Telescope (JWST). To address the technology challenges of both Directorates, the SPACE Center conducts research and development in the areas listed in figure 5. The Center's website (http://www.calstatela.edu/orgs/space/) provides further details.

- Intelligent Flight Control, Autonomous Control, Formation Flying
- Uninhabited Air Vehicles (UAV) Development
- Wind-Tunnel Testing and Validations
- Optimization of Combustion and Propulsion Systems
- Bio-derived Liquid Fuel and Solid Propellant Development
- Thermal Analysis of Space Systems
- Space Telescope Technology, Precision Pointing, System Identification
- Decentralized Control, Failure Analysis and Reconfigurable Control
- Ubiquitous Computing and Embedded Architectures

Figure 5. The Space Center conducts research and development in the areas listed above.

In addition to doing research relevant to NASA's mission, the SPACE Center mission goal in education is to prepare the U.S. future workforce, train students in a NASA research development environment to prepare them for future employment, and to motivate them towards graduate studies. Dr. Boussalis discussed how the SPACE Center recruits student research assistants. The selection process includes an interview with the faculty and the SPACE Center director. Students are assigned to the faculty consistent with their expertise and interests. To improve retention, students work in groups and each student is assigned a mentor. A student council has been created to organize professional and social activities. Students are responsible to report the progress of their research weekly via email and at project status meetings. In the longer term, students participate in the preparation of NASA reports, presentations to NASA project reviews and industry advisory board meetings, conferences, exhibitions and meetings, and in preparing technical papers. Students are also involved in training high school and community college teachers and students.

The curriculum of the SPACE Center includes senior design projects, Master theses, and Ph.D. dissertations. Post-graduate data for the SPACE laboratory for the period 2003-2008 shows that 21 undergraduates have entered a Master's program at CSULA, while 3 have gone on to a Ph.D. program and 32 graduates have found employment in industry.

At the end of Dr. Boussalis's presentation, Dr. Pol Spanos, professor of mechanical engineering and materials science at Rice University spoke about the challenges for enhanced research interaction between universities and minority serving institutions that grant doctorate degrees. Some of

the challenges for MSIs include (1) providing a robust infrastructure to support research activities and controlling overhead costs; (2) avoiding precluding faculty from undertaking rewarding research projects by assigning excessive teaching loads; and (3) keeping students receiving BS degrees in a doctoral program, as opposed to going into industry.

III.7 Opportunities for Collaborations—Case Study with Hispanic Students at Polytechnic University of Puerto Rico

Dr. Wence Lopez, professor of controls, robotics and automation at the Polytechnic University of Puerto Rico (PUPR) and Director of the Puerto Rico Institute of Robotics (PRIOR), discussed his experiences building partnerships. PRIOR is a K-20 program that was created by an alliance between NASA, PUPR, the Puerto Rico government, and industry. The program is designed to inspire Puerto Rican students to stay in school and study careers related to STEM. Another goal is to increase the participation of under-represented Hispanics in NASA missions. The PRIOR program promotes robotics competitions as a means of getting students interested in STEM careers. By starting in elementary school and sustaining the program through middle school, high school, and university, the program establishes a pipeline that feeds into NASA, industry, and the private sector.

The mission of the PRIOR program is to create an institute of robotics to position Puerto Rico strategically as a research center to support the preparation of the robotics engineers of the future. PRIOR identifies and selects students from all levels to participate in a two-week summer camp. The students that participate in the summer camp become part of a team of 4 students that are then trained to compete in the annual robotics competition known as the "Technology Challenge." After the summer camp for 10 consecutive Saturdays, all the students selected receive intensive training on concepts of physics, math, pre-engineering, programming, structures, technologies, research and team work. During the training period the students build and program a robot to perform a specific task for a final competition. The development of these robots serves to teach and inspire students in concepts of STEM. These events are fun for the students, their mentors, their schools, and have proven to be a launching pad for the future engineering minds of Puerto Rico. The top performers of this event are invited to represent their school and Puerto Rico in the world championship event held in the United States.

The "Technology Challenge" has grown each year and now in 2009 spans 4 days with an expected attendance of over 16,000 people. NASA, industry, and government all are involved in the sponsorship. Approximately 100 teams will perform in the robotics competition. The technology challenge results in increased interest in STEM careers, a reduced drop out rate, and an increased number of students applying to the university. Some of the lessons learned in sponsoring the event include keeping the cost low, utilizing volunteers, balancing theory with practice, having a long-range plan, and finding sponsors.

III.8 Empowering Culturally Relevant Role Models

Dr. Sergio Morales, a post-doctoral researcher in microbial ecology at the University of Montana, discussed issues with empowering culturally relevant faculty role models. The first issue is the lack of culturally relevant faculty role models. For example, Science reported in 1999 that African Americans, Hispanics, and Native Americans account for only 7% of science and engineering Ph.D.s while accounting for 24% of the U.S. population. The low success rate for minorities in academia beyond the post doctorial level is viewed by other students from the same minority group as a deterrent. Part of the problem is that the average age of faculty has increased with time. For example, 25% of the faculty was 35 years old or less in 1973 compared to less than 10% in 2003. Meanwhile, the number of Ph.D.s competing for the few available faculty jobs has significantly increased. Therefore, statistically it is unrealistic to expect large advances in culturally relevant role models under current conditions. To increase the number of culturally relevant role models, universities and funding agencies must either provide financial support to universities for recruitment of junior faculty or financial support for early career minority researchers beyond the postdoc level and prior to tenure track positions.

The second hurdle is the lack of high quality, active research opportunities within minority institutions. In the current approach minorities are recruited mostly for the benefit of the host institution. Research grants are awarded to the host institutions, not the home (minority) institution. This approach is less effective as only a small group of students actually participate and benefit. He described an alternate model where the students received summer research training at the host university (e.g., University of Montana) and then continued research at the minority university (e.g., Chief Dull Knife College). He is also working on a similar arrangement with the University of Puerto Rico de Mayaguez. In both cases the grants are submitted directly through the minority institute. He showed how this model would work in his own research program looking at bacterial populations as indicators of greenhouse gas emission in soils. The benefits of this approach is that it enables culturally relevant role models to pursue high quality research in MSIs thereby making high-quality research available to the entire MSI population, allows the students to continue applying learned skills at their home institutions, and empowers the MSI to allocate resources where they see fit resulting in less oversight (and overhead) from outside institutions.

III.9 Build Partnerships and Strengthen Collaborations with the Liaison

Dr. Johanna Porter-Kelley, assistant professor of microbiology at Winston-Salem State University, discussed the concept of using a liaison to facilitate communication between NASA and minority institutions. She noted that communication is a monumental task considering that there are 105 black and 32 tribal colleges and universities in the United States. The challenge that NASA faces is to get information in the hands of those that can benefit from NASA programs to facilitate recruiting the brightest students that minority institution have to offer. In the past NASA has advertised programs and opportunities via web sites, but no one searches a web site unless they are looking for information.

Dr. Porter-Kelley's innovation is to use a liaison to disseminate information about NASA programs. A liaison would be someone that knows both the NASA programs and the inner workings of the university. They would know who could benefit from the information and how to best disseminate the information inside the university. NASA could contact department chairs and deans of science and engineering programs for suggestions on a person to serve as the liaison. NASA would then build a relationship with the liaison through such mechanisms as educational programs and workshops. The liaison could disseminate information by giving talks to alert faculty and students about NASA opportunities, and they could post fliers about opportunities and help students complete applications.

There was considerable discussion following Dr. Porter Kelley's talk. The liaison concept was well received by those in attendance, who felt that this idea had sufficient merit to warrant further consideration and perhaps a pilot program.

III.10 Implementation of an Interdisciplinary Education, Outreach and Human Resource Development in Nanoscale Science for the Hispanic Community

Dr. Ileana González-González spoke about the Center for Advanced Nanoscale Materials (CANM), a NASA URC at the University of Puerto Rico (UPR) directed by Dr. Carlos Cabrera. CANM is divided into four interdisciplinary research groups focused on life support systems, e.g., nanoporous sorbents for spacecraft air ultrapurification, advanced high-energy materials, non-carbon based sensors that can operate in harsh environments, and carbon-based sensors and biosensors. CANM research goals include innovation and commercialization, developing test-bed capability, and sustainability, e.g., pursuing follow-on funding from the Small Business Innovation Research (SBIR) and the Small Business Technology Transfer (STTR) programs. Key partnerships include three NASA Centers (ARC, GRC, and JPL) and other national partners such as the Cornell Center for Materials Research.

CANM is heavily involved in educational and outreach activities. In partnership with other agencies, they have provided summer research experiences in nanoscience applications for 35 high school students and teachers at the UPR Rio Piedras, Mayaguez, and Cayey campuses. Participants also received training in basic nanoscience concepts, scientific research and communication skills, and educational field trips. Both students and teachers present their research results at the end of the internships. CANM trains their undergraduate and graduate fellows to help develop and implement outreach activities such as speaking to high school students, putting on workshops, and a nanoscience exposition at Plaza Las Americas shopping mall. The NanoSummer camp has served as a model to create summer research experiences for high school students and teachers. The program has resulted in a significant increase in the number of students and teachers impacted by the education and outreach team.

The presentation ended with a recap of the key accomplishments of CANM. The program has resulted in the creation of interdisciplinary groups that have targeted nanoscale materials research projects relevant to NASA. The major direct societal benefit of CANM has been the education, training, and development of 69 college students from underrepresented groups (primarily Hispanic) in NASA related nanotechnology fields, thereby enhancing the size and diversity of the national pool of qualified students. Therefore, CANM has been successful on three fronts—doing cutting edge research in the nanosciences, education and outreach into the K-12 schools, and in preparing minority students for careers in science.

III.11 An Emerging, Long-Term Collaboration: NASA and the Navajo Nation

Tom Davis, dean of instruction at Navajo Technical College in Crownpoint, New Mexico, spoke about an emerging long-term collaboration between NASA and the Navajo Nation. He laid the background by describing the Navajo nation, which encompasses a rural and frontier like area the size of West Virginia. The community is generally very poor with unemployment rates in some communities near 100%. The average Indian student can't do fractions, and the dropout rate is around 65%.

What do NASA and the Navajo nation have in common? Both have accomplished miracles. NASA has put rovers on the surface of Mars. Navajo Technical College has accomplished miracles of its own by building a tribal college movement out of seven students with degrees. NASA has worked hard with Navajo Technical College to produce a wireless network, which has enabled participation in the NASA Lunar Crater Observation and Sensing Satellite (LCROSS) mission with kids from places like White Horse. He noted that part of what NASA gives us is the ability to set dreams in the heads and hearts and spirits of students. It gives us the ability to tell them, "You too can reach for the skies. You too can go places no Navajo has ever been before."

To achieve the goals of NASA, such as going to Mars, demands a certain mindset, attitude, and spirit, which says no matter how difficult the challenge we can succeed. The challenge of White Horse is commensurate. There are few resources for White Horse and most of the students at the elementary school in White Horse will not graduate from college or high school. The majority will be out of school by the time they are in the eighth grade. Those who graduate will come into the college (if we work hard enough to get them into the college), but they will not know how to read or write or do fractions. The challenge of White Horse may be as difficult as the challenge of physically getting to White Horse.

The problems of White Horse are not going to be solved by three or five year grants. We've tried that since Lyndon Baines Johnson, and it hasn't gotten the job done. Tom stated "So while I have deep gratefulness for what NASA has done, I want NASA to remember as it spins dreams for all

of humankind and goes to places that no human has ever gone before, as they create their technical and scientific wonders, that they also have a role in helping minority serving institutions achieve what is even more impossible than what they are technically achieving. And they can do that through resources, through people, and through the magic of dreams they are creating. But mostly they can do it by simply understanding and listening and digging deep inside the know how and the spirit and the idea of mission toward those who most need their help and most need what they have to offer."

This very passionate speech by Tom Davis, resulted in considerable discussion centered on the theme that not all minority institutions are created equal. The point was stressed that NASA must truly have insight into the nature of the institutions it is trying to help.

IV Collaborative Models/Strategies for Increasing Minority Participation

IV.1 The University of Montana Native American Research Laboratory

Michael Ceballos, research assistant professor at the University of Montana and director of the University of Montana Native American Research Laboratories (NARL), spoke about collaborations between NASA and tribal colleges and universities (TCUs) and major universities. He noted that none of the ~35 accredited TCUs offer a master's or doctoral degree in science and engineering. There are several important issues that make it more difficult to increase minority participation at TCUs than other minority serving institutions. For example, sending students off for summer research internships is not always productive, in part, because the students are often uncomfortable in a setting where there are no culturally relevant faculty role models or mentors. Within the TCUs themselves, the science faculty have high teaching loads, which results in a lack of research activity and collegial research relationships. What are needed are tenure-track academic positions for Native American faculty who are actively engaged in research and who can serve as culturally relevant role models. However, a tenure system is something that the TCU community will have to establish from within. In the meantime, a significant boost in support of the few Native American science faculty at major universities is immediately needed. Also needed is a "bridge" program to address the deficiencies of Native American students in math and science, so that they can become competitive in traditional university labs and competitive for graduate school.

NARL was established in 2007 to provide "hands-on" research opportunities for Native American undergraduate students, graduate students, and, even, high school students in a highly interdisciplinary and cross-cultural research setting. NARL provides students with "cutting-edge" research opportunities and access to modern instrumentation. In the first two years of operation, NARL has served more than 55 students, two-thirds of who are Native Americans representing more than 20 tribes. Every NARL student research project to date has been established based on active research collaborations between NARL and ARC. NARL has built ties with other minority serving institutions such as Tennessee State University (TSU), an HBCU, and the University of Puerto Rico (UPR), an HSI. However, while NARL has sufficient funds to carry out core research efforts via funding from NASA and the National Science Foundation (NSF), it lacks sufficient laboratory space to train students and to expand its collaborations with TSU and UPR.

Ceballos ended his presentation by stressing the following points: To increase TCU participation in STEM disciplines, it will be necessary to support culturally relevant faculty in tenured positions especially at major universities where graduate degrees are offered, and to have Native American programs at both TCUs and major universities directed by Native American faculty. We must recognize all three sub-populations of Native American students: (1) those who enter major universities directly out of reservation-based high schools; (2) those who enter major universities from non-reservation/urban areas; and, (3) those who transfer from TCUs. Funding should not be left unbalanced so that non-TCU American Indian and Alaska Native students are overlooked. Finally, we must develop a significant training facility for interdisciplinary research in a cross-cultural learning environment with modern instrumentation guided by culturally relevant research mentors.

IV.2 Outreach to Hispanic Community

Rafaela Ornelas-Schwan spoke about the programs within the organization now known as Great Minds in STEM, but formerly known as Hispanic Engineer National Achievement Awards Corporation (HENAAC). The name change reflects an expanded role in K-12 education programs and other efforts to promote STEM careers in underserved communities all over America. She described a number of on-going programs within the organization. One of the organization's key programs is Viva Technology, which is designed to engage inner city and rural K-12 students, teachers, and parents in the applications of technology to stimulate interest in STEM careers. The program includes students, teachers, and parents. Details of the Viva Technology student day, parent night, teacher program, school assembly, and etc. programs can be found on the organization's web site, http://www.henaac.org/vivatechnology/program.php. Since its inception, the Viva Technology program has been implemented in 13 states, and has directly impacted over 50,000 students, teachers and families. In addition to the Viva Technology program, Great Minds in STEM has undergraduate and graduate workshops, scholarships, internships, school fairs, educator awards, and poster competitions.

The vision of Great Minds in STEM is to keep America technologically strong by promoting STEM careers, especially in underserved communities. Its mission is to educate, motivate and enable more underserved students to achieve careers in STEM, to develop and leverage Hispanic STEM talent to play a leadership role, to engage families, educators and employers to support underserved students and communities in STEM careers, and to inspire our nation through recognition of the achievements of Hispanics and other role models in STEM. Further information about the Great Minds in STEM organization is on their website www.greatmindsinstem.org.

IV.3 Successful Research Collaborations and Student Educational Programs Involving Spelman College and NASA

Dr. Albert Thompson, Jr., professor of chemistry at Spelman College, discussed the collaborations between Spelman College and NASA. Spelman College located in Atlanta, Georgia, has approximately 2100 full-time students, 25% of which are science majors. About 50% of science graduates pursue graduate and professional degrees. In 1978, Spelman College offered STEM degrees in only biology, chemistry, and mathematics. The program has expanded significantly since then—adding degrees in physics, biochemistry, computer science, engineering, and environmental science.

Since 1987, Spelman College has been sponsoring the Women in Science and Engineering Scholars (WISE) program through a NASA grant. The goal of the WISE program is to increase the number of underrepresented minority women in scientific and technical careers. Of the more than 320 women who have participated in the WISE program, more than half have received graduate degrees, and at least 40 have earned doctoral degrees.

Dr. Thompson discussed some of the research that has been carried out at Spelman College with NASA funding. Spelman College was also part of the NASA alliance for nonlinear optics consortium (1994-2004), a group of seven faculty at five different universities working to develop nonlinear optical materials. Early NASA funding helped Spelman College succeed as one of six

institutions selected by the National Science Foundation (NSF) in the Model Institutions for Excellence (MIE) program. The principal goal of the MIE program is to strengthen STEM education and research training programs. Components of the program include undergraduate education and research, faculty and student development, and infrastructure improvement.

Dr. Thompson also briefly discussed the NASA Students Pursuing Academic and Career Excellence (NSPACE) summer research program administered by Spelman College in partnership with NASA, Chicago State University, Texas Southern University, and the Atlanta, Chicago, and Houston public school systems. It is a pre-college program designed to provide high school students with research experience, and to expose them to professional opportunities in STEM fields.

In conclusion, he discussed some of the reasons that Spelman College has achieved the status of a model institution. These include visionary leadership, a committed faculty and administration, good role models, a talented student research pool, and resources such as funding from NASA. To build and sustain a successful STEM program at a minority institution, it is necessary to build self-confidence, a nurturing environment, and a sense of belonging in science and mathematics. It is also necessary to increase student scholarships and to maintain a high quality educational infrastructure.

IV.4 Advancing Latinas in Computing

Dr. Gilda Garretón, researcher at Sun Microsystems, discussed the efforts of a grassroots community established in 2006 called Latinas in Computing (LiC). Their mission is to define key strategies to help promote leadership and professional development among current and future generations of Latinas. This effort is needed to address the lack of women with graduate degrees in science and engineering in the Hispanic community. Based on an NSF survey of earned doctorates in 2006, of the 16,000 doctoral degrees in science and engineering, less than 5.2% were Hispanic and less than 3% were Hispanic women. The LiC community membership includes students, faculty, and representatives from industry, non-profit organizations, and government labs. The organization has a presence on websites such as Facebook and LinkedIn and through campus ambassadors.

With the help of the Anita Borg Institute for Women and Technology (ABI), LiC is bringing their message to the Latinas community through the Grace Hopper Celebration (GHC) conferences, CRA-W Grad Cohort workshops, and Computing Alliance of Hispanic-Serving Institutions (CAHSI) meetings among others. GHC conferences are designed to bring the research and career interests of women in computing to the forefront. Leading researchers present their current technical work, while special sessions focus on the role of women in today's technology fields, including computer science, information technology, research and engineering. Past Grace Hopper Celebrations have resulted in collaborative proposals, networking, mentoring, and increased visibility for the contributions of women in computing. These conferences have grown in size each year since they were first introduced in 1994. GHC scholarships are now awarded each year to cover part of all of the cost of attending the conference. The goal of LiC is to inspire others to succeed through the mentoring, support, and passion that the conferences like GHC generate. She ended her presentation by showing a motivational movie created by the Anita Borg Institute entitled "I am a Technical Woman", available on ABI's website and YouTube.

IV.5 A Model for Meaningful Research Collaborations: The NASA Science and Technology Institute for Minority Institutions Project

Aaron Andrews, president and CEO of the United Negro College Fund Special Programs Corporation (UNCFSP), spoke about the NASA Science and Technology Institute (NSTI) for minority institutions (MIs). The UNCFSP was established in 2000 as an independent 501(c)(3) non-profit organization to address educational issues that impact MIs. The organization's mission is to serve as "the portal" between the vision of minority institutions and the funding priorities of the Nation. The NSTI is a NASA-funded cooperative established in 2006 in the NASA Research Park at Moffett Field, CA. A key goal of the institute is to create a research consortium that connects intellectual talent at minority institutions with opportunities in the Federal government, private industry, and other organizations. Another important aspect is the professional development training that comes from bringing students and faculty from minority institutions together with NASA scientists in a research and development (R&D) enterprise.

The NSTI project is broken out in greater detail in figure 6. There are currently three clusters/trusts of minority institutions. The research clusters/trusts complete R&D tasks that complement their host NASA Center. They work in teams composed of faculty and students from minority institu-

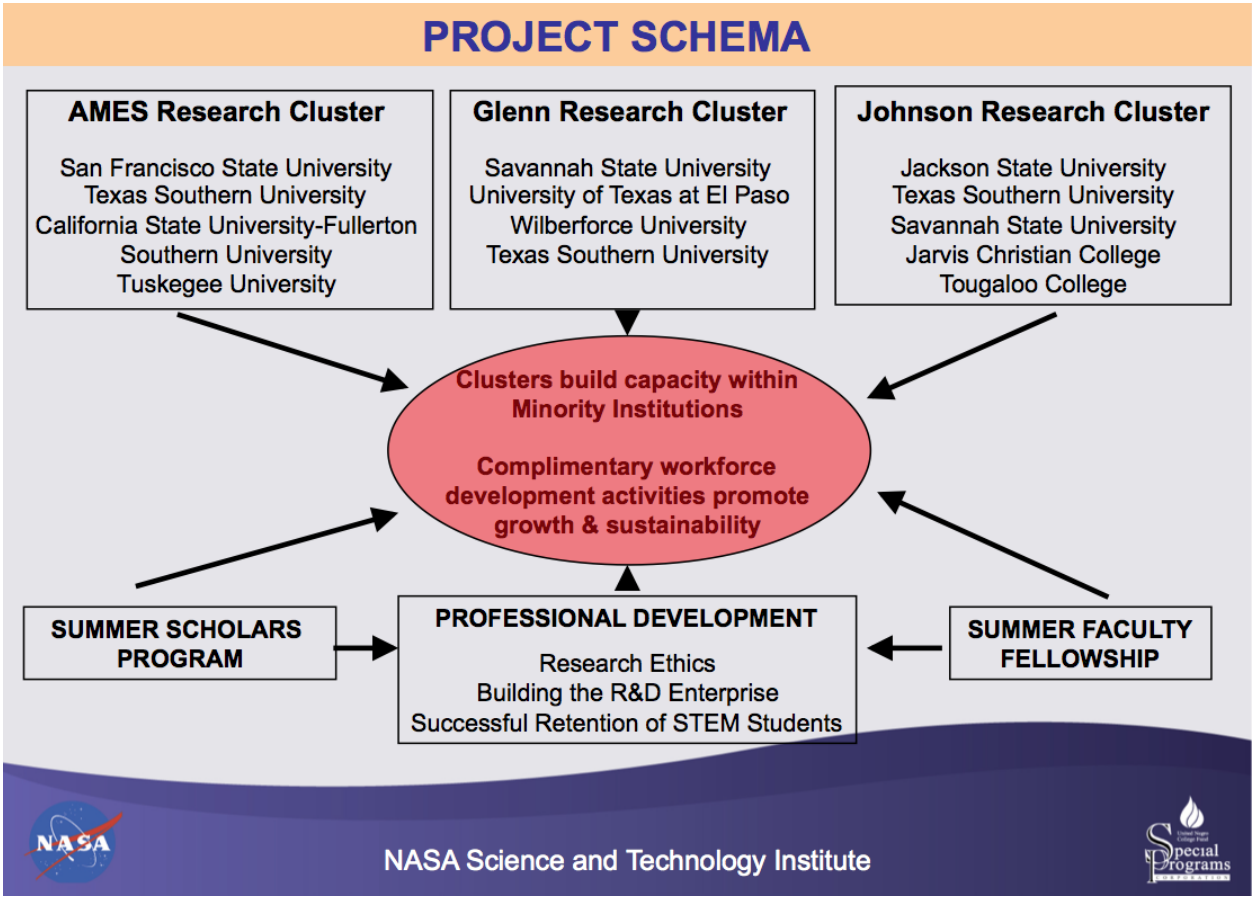

Figure 6. Project schema for the NSTI project.

tions, NASA, partnering majority institutions, and other private and government organizations. Six additional clusters/trusts are planned over the next three years. Mr. Andrews described in some detail the research focus of each cluster. For example, the research cluster at ARC is carrying out work in networking and intelligent/adaptive systems, supercomputing, nano-scale science and technology, air traffic management, and thermal protection systems, which align with the core competencies of ARC.

The new research capacity developed through the NSTI program will enable MIs to garner additional funding and to augment courses in the STEM disciplines. The Summer Scholars program provides 10-week research and training opportunities for underrepresented students and faculty. Some of the accomplishments of the NSTI to date include research publications in peer-reviewed journals, new or revised STEM courses at MIs, and the establishment of mentor/mentee relationships between NASA scientists, students, and faculty. The NSTI is an ideal model for creating a mechanism of advancement for faculty, students, and other professionals that yield mission-driven research, a strengthened STEM workforce, and the foundation for sustained STEM workforce development.

IV.6 Center for Bio-nanotechnology and Environmental Research (CBER)—Using a NASA University Research Center to Illustrate the Potential to Increase Minority Participation

Dr. Olufisayo Jejelowo, director of the Center for Bio-nanotechnology and Environmental Research (CBER), discussed how a NASA University Research Center (URC) such as CBER could increase minority representation within NASA. The host university for CBER is Texas Southern University (TSU), an HBCU in Houston, Texas. CBER has both research objectives, such as addressing environmental and human health concerns related to manned exploration in Space, and an educational objective of developing a future workforce in STEM fields.

The workforce challenge for NASA is how to increase recruitment from minority serving institutions. The first issue is the trends in STEM student enrollment, retention, and graduation. In figure 7 are depicted the education milestones by race/ethnicity and gender. Only a small fraction of the advanced degrees in science and engineering are being awarded to minority students. STEM undergraduate student enrollment is declining among blacks and Native Americans. Overall the United States trails most developed countries in the percentage of university students receiving their first degrees in science and engineering. The workforce development plan within CBER seeks to improve student recruitment and retention with a TSU faculty and student development plan, an undergraduate summer internship program, and outreach programs. Specific objectives include a CBER scholars and fellows program, curriculum improvement, activities that provide early exposure of students to STEM fields, and seminars, workshops, and symposiums. The seminar series at TSU has been very successful and has been expanded to include seminars by students as well as faculty.

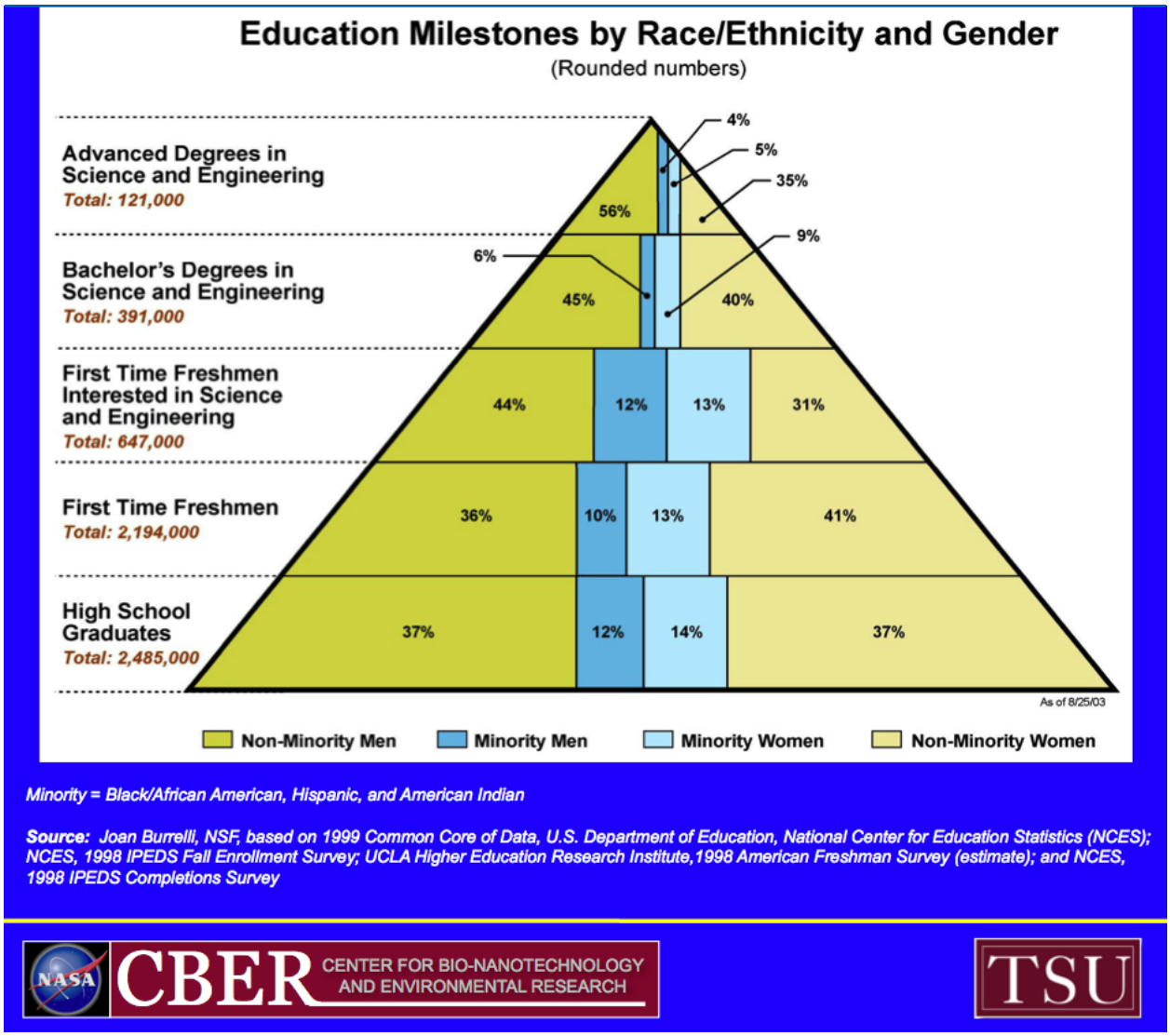

Figure 7. This graphic depicts education milestones by race/ethnicity and gender.

The three main technical areas of research within CBER are radiation and microgravity, space microbiology, and biosensors, bio-informatics, and bio-nanotechnology (BBB). The objectives of the radiation and microgravity thrust are to investigate the simultaneous effect of radiation and microgravity and to develop countermeasures to mitigate their effects. Research in the space microbiology thrust seeks to understand the effect of space on microbial evolution, ecology, growth kinetics, morphology, and virulence. The BBB thrust objectives include developing a microarray-based platform to identify microbes in space, developing portable microbial detectors, and developing a system that detects proteins for microbial identification. This work within CBER has resulted in URC Microbial-1, the first space flight opportunity for TSU. The URC Microbial-1 flight experiment (recently conducted) has been an opportunity to provide undergraduate and graduate students the unique environment of space as part of a formal classroom, and a laboratory research experience to encourage learning and interest in STEM.

IV.7 Recommendations to Improve Hispanics Participation in NASA's Programs

Dr. Yolanda Serrano, professor at the Inter-American University of Puerto Rico, spoke on how NASA could improve the participation of Hispanics in its programs. The Inter-American University of Puerto Rico (IAUPR) is the largest private university of the Caribbean with an enrollment of over 42,000 students, 99% of whom are Hispanics. This constitutes approximately 25% of the total Island's college students and 40% of the students who attend the Island's private higher education institutions.

Dr. Serrano described a survey that was carried out to assess the student's knowledge of NASA research opportunities. A questionnaire was administered to 100 students primarily from the areas of engineering, informatics, and science. Interviews were made to professors of different areas and to students that participated in NASA's summer internship program. Most of the students were between their second and fourth academic years. Approximately 88% responded that they were unaware of any research programs on campus, but 77% responded that they were interested in participating in research programs. Although there is a NASA representative (Professor Rafael Canales) on campus, most students were unaware of that fact. Clearly, the dissemination of all the opportunities NASA has to offer to the campus community is a large challenge. Also challenging is informing students about the offices or personnel responsible to notify them about research opportunities.

To increase the awareness of NASA activities, she recommended increasing the involvement of the faculty at IAUPR in NASA research activities, and performing activities with students who have participated in NASA's programs together with those interested in future opportunities (student to student mentoring). She recommended modifying NASA's home page with a click bar for minority opportunities and promoting the visit of NASA's recruitment officers to campus. Language concerns dictate that those individuals interacting with the IAUPR campus should ideally speak Spanish. The dissemination of information about NASA research opportunities is clearly a major challenge at a university the size of IAUPR, even when a NASA representative is resident on campus.

V. Breakout Sessions

In the afternoon, the workshop participants broke into three groups to discuss three specific questions in more detail. Each group contained representatives from NASA Headquarters, NASA Ames, an HBCU, a TCU or Native American, an HSI and major outside organizations.

V.1 What are the Key Strategies for Initiating and Sustaining Partnerships?

While NASA understands the need for a diverse workforce, developing an effective strategy to accomplish this is the challenge. One of the key problems is simply bringing NASA opportunities to the awareness of the MI community. NASA should consider funding advisory people (liaisons) to facilitate the communication. Also it would be useful to have a "go to" person at NASA to answer questions about how to apply for NASA opportunities. NASA needs to develop a better system for tracking students with NASA involvement through their academic and research careers. This is essential if NASA is to establish a pipeline for bringing highly qualified students into the NASA workforce. It was suggested that a consolidated list of people and research interests at each institution be created and put on a website with cross-links to home institution/key words/host institution, etc.

One idea was to develop a virtual community of MI students using the NASA Astrobiology Institute (NAI) as a model. In principle, MI students participating in NASA programs could be in constant communication. The virtual institute could be the mechanism for developing other activities, such as a technical conference for MI students to present their research results. The virtual community could be self-sustaining and might be able to leverage funds and political support. Dr. Person indicated that NASA was moving along these lines with the recent establishment of the NASA Student Ambassadors Virtual Community. Members will interact with NASA, share information, make professional connections, collaborate with peers, represent NASA in a variety of venues, and help NASA inspire and engage future interns. More information can be found on the website http://intern.nasa.gov.

The issue of sustainability is a major issue. For example the University Research Centers are funded for five years. How do we ensure that this newly seeded research activity continues to prosper after five years? Since long-term funding projects are unlikely to happen again at NASA, there needs to be a transition to other funding. The NASA Mission Directorates are one potential source of funding as are NASA research announcements.

MI faculty should sign up to receive NASA Research Announcement at NSPIRES (http://nspires.nasaprs.com/external/). Through this site, NASA solicits research through the release of various research announcements in a wide range of science and technology disciplines. NASA uses a peer review process to evaluate and select research proposals submitted in response to these research announcements. This site facilitates the search for NASA research opportunities. MI faculty needs to get more involved in this review process, but how does a faculty member from a minority institution get invited to a review panel?

To address the institutional challenges of disseminating research opportunities, a "Liaison Website/Portal" concept was suggested as a one-stop site for all NASA outreach events and opportunities. An initial attempt at doing so is the ongoing work to update the MU-SPIN website (http://muspin.gsfc.nasa.gov/) and link it to a website at Johnson Space Center.

The NASA Administrator's Fellowship Program was viewed positively for it ability to generate real partnerships. The program involves personnel exchanges between minority institutions and NASA.

Finally, it was suggested that another meeting of minority institutions, similar to the one held in Chantilly, Virginia four years ago, be conducted as a means of initiating partnerships between MIs.

V.2 What does NASA do well and what could they do better to strengthen collaborations with minority institutions?

The first issue is the level of commitment. Fewer minority students receive funding today than previously due to cuts in the overall educational budgets. There is hope that the current administration will reverse these trends. Another idea that surfaced is that greater benefit arises to the MI community when NASA projects are taken to MI universities than when individual students participate at a NASA center. This may be particularly important for Native American students that do not feel comfortable at a NASA center, especially in the absence of culturally relevant mentors.

NASA also needs to devise better tracking systems for MI students participating in NASA programs. This need is being addressed at NASA Headquarters with the development of the Office of Education Performance Management (OEPM) database, which will systematically track students. Communication of NASA opportunities within the MI community is an on-going problem. One of the focuses of this workshop was to identify websites that identify opportunities for minority serving institutions.

The workshop participants did identify NASA educational programs that are working well. For example, representatives from several of the current NASA University Research Centers (URCs) felt that the URC program was a win for both NASA and MI universities. They presented metrics that demonstrated that MI students were getting degrees in STEM fields. Issues are the sustainability of these programs past their initial funding of five years. A continuing problem is the lack of opportunities for MI graduates in tenure-track faculty positions.

V.3 What metrics and measurements are needed to monitor progress?

Performance metrics include the number of degrees awarded in the STEM fields (B.S., M.S., and Ph.D.), the number of MI faculty in universities, and the number of peer-reviewed publications published by MIs. Student employment achievements and attendance at national minority conferences, such as the National Society of Black Physicists (NSBP), the Hispanic Physicists (NSHP), and the National Society of Black Engineers (NSBE) are another measure. Obtaining accurate metrics relies on having a good tracking system and database such as OEPM.

Another valuable database is the Integrated Science and Engineering Resources Data System (WebCASPAR), which provides easy access to a large body of statistical data resources for science and engineering at U.S. academic institutions. The National Science Foundation Science Resources Statistics Division maintains WebCASPAR (http://webcaspar.nsf.gov/). Surveys such as the baccalaureate origins of STEM doctorate recipients, provides information that reflects the strength of the undergraduate programs in producing the intellectual leadership in STEM fields. It is an invaluable resource for evaluating the strength of undergraduate STEM programs.

VI. Final thoughts - Key Points to Make to Administrator Charles Bolden

In the final session we asked the participants to summarize their key recommendations by asking them the question: "If you were in an elevator ride with NASA Administrator Charles Bolden, what would you say to him regarding the topic of the workshop?" The responses below represent a partial list of individual opinions, but taken together reflect the overall thinking of the attendees.

"The future of our scientific enterprise and our country's security depend upon NASA reaching and training under-represented minority STEM professionals. New and effective ways to attract this continuously untapped resource must be developed." *Marian Johnson-Thompson*

"We need to convey the importance of NASA programs and how they bridge each other, for example the NASA Administrator Fellowship Program provides a valuable linkage between NASA and minority institutions." "We need focused communication to make it easy to find NASA information on its programs and opportunities. On the institution side, we need focal points for dissemination of NASA information." *Mike Liu*

"There's a great untapped resource eager to be fully engaged in the work of NASA's minority education programs. NASA can and must do a better job of identifying, tracking, stimulating and investing in those human resources who will make NASA successful in the future." *Steve Zornetzer*

"Education is key to NASA sustainability of its mission—please don't compromise on education funding. Reach out to the cross section of the national communities—you will be amazed as to the raw talents waiting to be discovered. Listen to ideas from minority constituencies on ways to improve program reach and coverage." *Ben Oni*

"It struck me in this weekend's program that so many of the presentations focused on the heroic efforts of folks in academia and NASA. Yet we need to wrap an organizational strategy around these efforts, linked to the work of the Mission Directorates and Centers, in order for this investment to be sustained as these folks move on in their careers. *Karen Flynn*

"NASA can benefit with respect to students by being a lead agency in the development of the intellectual leadership in the core competencies. NASA can benefit with respect to maximizing its interactions with MSI faculty by improving dissemination of core information concerning NASA programs. NASA can benefit with respect to MSI universities by improving the impact of broadening participation in NASA sponsored programs." *Jerry Bramwell*

"NASA should increase funding for research initiatives for minority institutions in interdisciplinary fields such as astrobiology. I believe the landscape of science is no longer the same and interdisciplinary science programs must become a priority in science education to increase the STEM pipeline. Astrobiology encompasses all sciences and it is one of the easiest and most effective ways to stimulate young minds." *Benita Bell*

"Please work to inspire all of American culture by educating and employing young people who want to support NASA's mission." *Matthew Reyes*

AGENDA

Minority Institution Workshop			
		DAY ONE Sat, October 24th	
Time	**Dur.min**	**Description**	**Speakers & Discussion leaders**
8:00	30	Registration	
8:30	5	Logistics	Stephanie Langhoff, ARC
8:35	10	Welcome/objectives	Pete Worden, Director ARC
8:45	15	Introduction of Participants	Stephanie Langhoff
NASA's Educational Programs			**Chair: Karen Bradford, ARC**
9:00	25	Overview of NASA's Minority University Research and Educational Projects	Carl Person, NASA Hqs.
9:25	15	Discussion	
9:40	20	The Meyerhoff Experience: Addressing Diversity through Excellence in Science and Engineering Education and Mentoring	Earnestine Baker, University of Maryland–Baltimore County
10:00	15	Discussion	
10:15	15	Break	
10:30	15	How to Strengthen the STEM Scholars Programs that Target Minorities and Women	Bernice Alston, NASA Hqs.
10:45	10	Discussion	
10:55	15	NASA's University Research Centers: A Win-Win for NASA and Minority Institutions	Katrina Emery, DFRC
11:10	10	Discussion	
11:20	15	NASA Ames Minority Institution Education Outreach	Brenda Collins, ARC
11:35	10	Discussion	
11:45	15	How to Propose Research to NASA ARC	Bea Morales, ARC
12:00	10	Discussion	
12:10	60	Lunch	
Building Partnerships with Minority Institutions- Part I			**Chair: Todd Gary, TSU**
13:10	15	How my students ended up playing baseball with aliens: 'Impact' of the NASA Astrobiology Minority Institution Research Support	Aaron Cavosie, University of Puerto Rico
13:25	10	Discussion	
13:35	15	What's in a word (or a picture)? Constructing and demolishing roadblocks to community	Linda Billings, George Washington University
13:50	10	Discussion	
14:00	15	Bridging the Gap: Case Studies of What Works Well in the Preparation of Students from Traditionally Underrepresented Groups for a Future Career in the Space Sciences	Erik Melchiorre, California State at San Bernadino
14:15	10	Discussion	
14:25	15	National Hispanic University Collaborations with Ames Research Center	David Johnson, National Hispanic University
14:40	10	Discussion	
14:50	15	Minority and Woman Training in Advanced Photonics	Robert Alfano, The City College of New York
15:05	10	Discussion	
15:15	15	The Accomplishments and Challenges of the SPACE University Research Center	Helen Boussalis, Cal. State Univ., LA/Pol Spanos, Rice University
15:30	10	Discussion	
15:40	15	Break	

AGENDA

Minority Institution Workshop			
		DAY ONE CONTINUED Sat, October 24th	
Time	**Dur.min**	**Description**	**Speakers & Discussion leaders**
Building Partnerships with Minority Institutions- Part II			**Chair: Melissa Kirven-Brooks, ARC**
15:55	15	Opportunities for Collaborations- Case Study With Hispanic Students at Polytechnic University of Puerto Rico	Wence Lopez, Polytechnic University of Puerto Rico
16:10	10	Discussion	
16:20	15	Empowering Culturally-Relevant Faculty Role Models	Sergio Morales, University of Montana
16:35	10	Discussion	
16:45	15	Build Partnerships and Strengthen Collaborations with the Liaison	Johanna Porter Kelley, Winston-Salem State University
17:00	10	Discussion	
17:10	15	Implementation of an Interdisciplinary Education, Outreach and Human Resource Development in Nanoscale Science for the Hispanic Community	Ileana González-González, University of Puerto Rico
17:25	10	Discussion	
17:35	15	An Emerging, Long-Term Collaboration: NASA and the Navajo Nation	Tom Davis, Navajo Technical College
17:50	10	Discussion	
18:00		Adjorn	
19:00		DINNER: Chef Chu's, 1067 N San Antonio Rd, Los Altos	

Agenda continued on next page

AGENDA

Minority Institution Workshop			
		DAY TWO Sun., October 25th	
Time	**Dur. (min)**	**Description**	**Speakers & Discussion leaders**
Collaborative Models/Strategies for Increasing Minority Participation			**James Harrington, GSFC**
8:30	15	The University of Montana Native American Research Laboratory	Michael Ceballos, University of Montana
8:45	10	Discussion	
8:55	15	Outreach to Hispanic Community	Rafaela Ornelas-Schwan HENAAC
9:10	10	Discussion	
9:20	15	Successful Research Collaborations and Student Education Programs Involving Spelman College and NASA	Albert Thompson, Jr., Spelman College
9:35	10	Discussion	
9:45	15	Advancing Latinas in Computing	Gilda Garreton, Sun Microsystems Laboratories
10:00	10	Discussion	
10:10	15	Break	
10:25	15	A Model for Meaningful Research Collaborations: The NASA Science and Technology Institute for Minority Institutions Project	Aaron Andrews, UNCF Special Programs Corp.
10:40	10	Discussion	
10:50	15	Center for Bionanotechnology and Environmental Research (CBER) - Using a NASA University Research Center to Illustrate the Potential to Increase Minority Participation	Fisayo Jejelowo, Texas Southern University
11:05	10	Discussion	
11:15	15	Recommendations to Improve Hispanics Participation in NASA's Programs	Yolanda Serrano, Inter American University, Bayamon, Puerto Rico
11:30	10	Discussion	
11:40	60	Lunch	
Breakout Sessions			
12:40	5	Introduction to Breakout Sessions	Stephanie Langhoff
12:45	90	(1) What are the key strategies for initiating and sustaining partnerships? (2) What does NASA do well and what could they do better to strengthen collaborations with minority institutions? (3) What metrics and measurements are needed to monitor progress?	Chairs: 1-Carolina Blake (ARC); 2-Mellissa Kirven-Brooks (ARC); 3-Benita Bell (GSFC)
14:15	15	Break	
14:30	30	Reporting of Breakout Groups	Session Chairs
15:00	45	DISCUSSION: Summary of Key Points and Future Actions?	Karen Bradford
15:45		Adjourn	

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A group photo of the participants at the conclusion of the workshop.